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METHOD FOR TESTING OF WEIGHING AND MEASURING DEVICES

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "**SAFETY AND HEALTH**" in Section J of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

A. SCOPE

The procedures used for testing and approving weighing and measuring devices used in materials processing plants are described in this method. This method is divided into the following parts:

1. General Procedure for Testing and Approving Weighing and Measuring Devices.
2. Test Procedure for Hopper or Tank Scales with Automatic Indicators.
3. Test Procedure for Hopper or Tank Scales with Batch Beam or Beams with Over-Under Indicators.
4. Test Procedure for Meters (Asphalt, Epoxy or Water) as used for Proportioning Materials in Processing Plants and Trucks.
5. Test Procedure for Belt-conveyor Scales.
6. Test Procedure for Self-contained Belt Scales.
7. Test Procedure for Checking Accuracy of Drum-mixer Plant Proportioning Devices and Controllers.
8. Scale and Meter Tolerances.

PART 1. GENERAL PROCEDURE FOR TESTING AND APPROVING WEIGHING AND MEASURING DEVICES

A. GENERAL

A *pre-test inspection* of the weighing and measuring system and controls to be tested should be performed.

1. *Identification:* Note and record manufacturer's name, model number and serial number.
2. *Approval:* Determine whether the device, system or control has been either Type-approved for commercial use in the State of California in accordance with the requirements of Title 4, Chapter 8 of the California Administrative Code or has been tested and approved previously by the HQ Office of the Construction Program. An approved list of weighing and measuring devices, system and controls, including asphalt concrete drum-mixer plants, will be maintained by the HQ Office of the Construction Program.

If the device, system or control is not included in the current list, California Test 109 should not be performed. The manufacturer of the device must request either, type-approval by the Division of Measurement Standards, if a commercial use is intended, or set a date for a Caltrans inspection for approval through the HQ Office of the Construction Program**,** if the device, system or control is to be used non-commercially.

NOTE: The Division of Measurement Standards (DMS) only type-approves devices that generate mass certificates. DMS does not type-approve interlocks or devices that aid in proportioning a mix but do not indicate the mass delivered.

3. Ascertain whether the indicating and recording elements are compatible with the intended use and are located properly.

4. Make a visual inspection of the device's details: i.e., levers horizontal and free from binds, linkages and connectors hanging plumb, counter-masses free from other moving parts and secured from random movement, knife edges and pivot points clean and free from binds, badly worn or otherwise defective parts. Any faulty condition that can be detected visually should be corrected before continuing with California Test 109.

B. TESTING

All weighing, measuring and plant-control systems, except for asphalt concrete drum-mixing plants, must be tested for accuracy at least once a year or upon each repair or moving of the plant to a new location. Asphalt concrete drum-mixing plants must be tested for accuracy at least once every six months or upon each repair or moving of the plant to a new location. In any case, any device shall be tested as often as deemed necessary by the Engineer.

The initial procedure will follow the same sequence necessary to set the system's adjustable elements. The test is completed by checking other fixed points, such as each notch in a batch beam or between the quarter points on a dial indicator. At the option of the Engineer, certain of the above steps may be eliminated. The total test load is to be at least equal to the intended operating capacity.

If an automatic batching system with remote indicators is used, these remote indicators become the primary indicators.

When commercial class test masses are used, they shall be compared to California State Standards and certified by an authorized representative of the California State Department of Food and Agriculture, Division of Measurement Standards. These standards shall conform to the specifications and tolerances for commercial standards as established by National Institute of Standards and Technology. This comparison shall be performed at least once every five years.

The contractor shall be responsible for providing access, any modifications, special equipment and labor necessary to perform the inspection and testing.

The contractor shall notify the Engineer at least 24 h in advance of testing the device, system or controls. The Engineer, or Weights and Measures coordinator, will witness the test and record the necessary information on Form HC-0014. A copy of the HC-0014 is to be sent to the HQ Office of the Construction Program, immediately. Another copy is to be furnished to the plant engineer. The Engineer will affix an HC-17 (departmental sticker) on each device found to be accurate by the test. The HC-0014 record sheet should contain the time required to perform the testing.

The Engineer will seal all adjusting elements that change the measuring device's accuracy upon witnessing acceptable accuracy of the device. Any time these seals are broken, without the Engineer's witnessing that there has been no change in the adjusting elements, the measuring device shall be re-tested for accuracy and resealed after being found accurate. Refer to Section 9-1.01, paragraph 4, "Measurement of Quantities," of the July 1999 Standard Specifications. The owner of the device is responsible for providing the means to seal the device.

A test shall be performed upon each newly installed, repaired or relocated weighing or measuring device, or when any elements have been adjusted.

All interlock settings shall be tested for accuracy.

There shall be a manufacturer's manual of operating instructions available at the control panel of each automatic batching and drum-mixer control system. This manual shall contain the procedure for checking interlock-tolerance settings and means of determining span-adjustment settings for computerized controls. Where automatic batch controllers are used the manual shall contain a detailed procedure of how to set controller parameters which meet Caltrans specifications.

A build-up test may be used in conjunction with test masses, to check a scale's high range. When a build-up test is required to complete the check, the contractor shall notify the Engineer sufficiently in advance to obtain approval of the build-up method intended to be used.

NOTE: See Build-up Test, Part 2.

All attachments to the scale, which are necessary for operation, shall be attached during the test of the weighing system's accuracy.

A dynamic test shall be performed before acceptance of the equipment's accuracy. This shall be accomplished by setting quantities for a batch into preset controls and comparing the preset masses with the masses actually batched.

PART 2. TEST PROCEDURE FOR HOPPER OR TANK SCALES WITH AUTOMATIC INDICATORS

A. INSPECT SCALE – SEE PART 1

Inspect the scale in accordance with the requirements of Part 1.

E. TEST SCALE

1. Check oscillations of indicator (when applicable). Adjust if necessary.

2. Set zero-load balance with all equipment on hopper for applying test load.

3. Lock dial (when applicable).

   a. Release locking mechanism; indicator should return to zero. Repeat procedure several times.

   b. Lock dial; shake hopper.

   c. Release locking mechanism; indicator should return to zero.

4. A corner and section test should be made if there are adverse conditions that could affect the accuracy of the scale, such as a damaged or altered part or altered factory adjusted setting, or whenever the device can be loaded off center.

   To accomplish a corner or section test, a load equal to 1/4 of the scale's capacity shall be concentrated at each of the load cells or main-lever bearings and 1/2 of the scale's capacity on main-lever section.

5. Apply test loads at 25 %, 50 %, 75 % and full capacity.

   a. Record the mass indicated at each loading.

   b. When applicable, lock the dial, and release locking mechanism. The scale shall repeat indicated mass within one minimum graduation.

   c. Remove load, and indicator should return to zero.

NOTE: The Engineer may require other intermediate loads.

NOTE: The Build-Up Test -- When there are not sufficient known masses available to test the weighing system to full capacity or means to hang all such masses, the Contractor must provide an acceptable means of building up or substituting other mass in place of the known masses. This requires approval by the Engineer.

A common means of build-up on hopper scales is to replace known mass with material (aggregate). This is done by first hanging available known masses to at least 1/4 of scale's capacity. Remove the known mass, and replace it by placing an equal mass of material in the hopper (equal to but not in excess of test load applied); then add the known mass again to the built-up mass. This procedure is repeated as necessary to attain capacity, but the total mass may not exceed four times the known mass.

An example of build-up test mass follows:

Condition: 10,000 kg aggregate weighhopper -- scale agency has only 2,500 kg of certified test masses. (All recording is to be done on Form HC-0014.)

1. Apply the 2,500 kg of certified test masses. Record indicated mass. Record plus or minus error (indicated mass relative to known mass applied, 2,490 kg indicated = -10 kg err.; 2,510 kg indicated = +10 kg err.); and remove known masses.

2. Place 2,500 kg of substituted mass (aggregate) into the weighhopper -- being careful that it is applied evenly to all corners of scale. Do not exceed the mass indicated in step 1. Record true mass. Indicated mass minus error recorded in

step 1. (A minus error in step 1 is added to indicated mass for true built-up mass, and a plus error in step 1 is subtracted from indicated mass for true built-up mass.) In other words, 2,490 kg indicated is equal to 2,500 kg actual mass, in the first instance; and 2,510 kg indicated is equal to 2,500 kg actual mass, in the second instance.

3. Reapply the 2,500 kg of test masses to the partially loaded hopper. Record applied known mass equal to 2,500 kg plus recorded true built-up mass of 2,500 kg = 5,000 kg. Record mass indicated and plus or minus error, as in step 1, and remove test masses.

4. Add more material in weighhopper equal to the test masses removed. Do not exceed previous, indicated mass. Record true built-up mass using same procedure as given in step 2.

5. Reapply the 2,500 kg of test masses, and add the true built-up mass from step 4, and record the newly applied test load, 7,500 kg Record the indicated mass and the algebraic difference from the applied test loads, as in step 1, and remove the known test masses.

6. Add more material in weighhopper equal to the test masses removed. Do not exceed the previously indicated mass in step 5. Record the true built-up mass using the same procedure given in step 2.

7. Reapply the 2,500 kg of certified test masses, and add the true built-up mass from step 6, and record the newly applied test load, 10,000 kg. This completes the application of test load to full capacity of scale. Record the mass indicated and the algebraic difference on Form HC-0014.

Any procedure of building-up mass which doesn't follow the aforementioned methods is not acceptable.

PART 3. TEST PROCEDURE FOR HOPPER OR TANK SCALES WITH BATCH BEAM OR BEAMS WITH OVER-UNDER INDICATORS

A. INSPECT SCALE – SEE PART 1

Inspect the scale in accordance with the requirements of Part 1.

B. TEST SCALE

1. Check oscillations of indicator; adjust if necessary.

2. Set zero-load balance:

   a. Of master beam with all equipment on hopper for applying test load.

   b. Of individual batch beams with beam balance positioned horizontally.

NOTE: Check SR (Sensibility Reciprocal) as each beam is balanced.

3. Lock out all beams, and shake hopper. Determine if scale maintained zero-load balance; it should be capable of repeating this indication.

4. Corner and section test. While inspecting the lever system, if there are any adverse conditions that could affect the main lever's accuracy (such as damaged or altered parts or altered factory adjusted settings, or where the hopper or tank can be loaded off center), a corner and section test shall be made.

   To accomplish a corner or section test, a test load equal to 25 % of the scale's capacity shall be concentrated at each of the main-lever bearings, and 50 % of the scale's capacity on a main-lever section.

5. Apply test load equal to fractional poise's capacities.

   a. Check accuracy of each fractional poise.

   b. Check accuracy of first graduated notch in each batch beam.

   c. Check accuracy of graduated weighing increments on over-under indicating chart.

6. Apply test load equal to the capacity of one batch beam. (If the beams are of varying capacities, start with beam of least capacity.)

   a. Check accuracy of each main poise of the batch beams while each is seated in its respective "capacity" notch.

   b. Check SR of each beam.

7. Remove test load equal to a batch beam's respective notched interval. Check accuracy of notch in each beam. Continue removing test load until all of the beam's notches have been checked.

NOTE: The need for checking every notch on the beams will be at the discretion of the Engineer.

8. Apply test load equal to sum of all beams capacities or to the heaviest mass to be batched.

    a. Check accuracy at total load.

    b. Check SR.

    c. Lock out all beams, and shake hopper. Determine if scale maintained indicated mass. It should be capable of repeating the mass indicated within one minimum graduation.

9. Remove test load. Determine if scale maintained zero-load balance.

NOTE: See Build-Up Test, Part 2.

PART 4. TEST PROCEDURE FOR METERS (ASPHALT, EPOXY, OR WATER) AS USED FOR PROPORTIONING IN PROCESSING PLANTS AND TRUCKS

A. INSPECTION

All installations shall be inspected visually for proper connections and conditions before tests for accuracy are performed.

1. The equipment shall be in a level position so that the indicator can be read easily and accurately and shall be readily accessible for making adjustments and applying lead and wire security seals.

2. An automatic siphon-breaker, or equivalent equipment, shall be installed in the discharge piping at the highest point of outlet, in no case below top of meter, to prevent siphoning from meter and permit rapid draining of pipe or hose. (This is not necessary on an asphalt or epoxy meter.)

3. A check valve, if necessary to prevent reversal of flow, shall be automatic.

4. A filter or strainer shall be provided to prevent passage of foreign material into the meter.

5. An air eliminator, or other effective means, shall be provided to prevent passage of air through the meter.

6. All leaks must be eliminated.

7. Units of measure used to indicate deliveries may be liters or tones. The maximum value of the smallest unit of registration shall not be greater than 0.5 L for delivery rates of less than 500 L per minute, and shall not exceed 5 L for delivery rates of 500 or more liters per minute.

B. TESTING EQUIPMENT AND PROVISIONS

1. Acceptable provisions for testing shall be incorporated into the meter's system and shall include a two-way valve or manifold valving, and a pipe or hose installed on the discharge line accessible to the proper positioning of the prover. Valving, piping or hose shall not be smaller than the actual discharge line.

2. Prover (for water meters only):

    a. Shall be of sufficient capacity to receive the amount delivered, as shown in the Accuracy Test Flow Rates in Table 1.

    b. Shall be maintained in a level position through the test runs.

    c. Shall be calibrated and certified according to the California State Standards as covered under General Procedures of this test procedure.

3. Further Provisions.

    a. Other receptacles or tanks shall be of sufficient capacity to receive at least 10 drafts, each equal to the amount metered per batch, consecutively drawn, or a continuous flow of 4,000 L. The meter shall be tested by using the same type and viscosity of liquid that is to be metered. The receptacle for checking the epoxy meter shall be of

sufficient capacity to contain a minimum of at least a 3-min flow of material through the meter at the maximum rate of flow of the operation.

b. The receptacle, or tank, and its connections shall be free from any leaks.

c. A suitable scale must be immediately available at the test site to obtain tare and gross masses of the receptacle, tank or distributor truck. This scale must be error-tested immediately before being used in connection with meter test. The scale for weighing the receptacle with epoxy should be of sufficient capacity to weigh at least a 3-min flow of material and have a minimum graduation of 0.005 kg.

d. A standardized thermometer must be available to check temperature at time of testing, unless a mass flow (coriolis effect) meter is used.

e. The Engineer will determine the true specific gravity for the asphalt or epoxy components being metered immediately prior to time of testing. The sample of asphalt shall be submitted to the Engineer at least 24 h in advance of testing. When a mass flow, coriolis effect, meter is used no specific gravity will be needed as no conversion will have to be done.

f. Formulas used to calculate the liters of asphalt at metered temperature from the kilograms of asphalt delivered by the meter during the test run:

(1) Calculate the kilograms of asphalt per liter at 15°C thus: Multiply the mass of one liter of water (1.00 kg) by the specific gravity of the asphalt at 15°C.

(2) Calculate the test run of metered asphalt in liters at 15°C thus: Divide the liters of metered asphalt by the kilogram per liters of asphalt as determined in Step (1).

(3) Convert the liters from Step (2) to liters at metering temperature. To do this, use an approved conversion table, such as Conversion Table 1 of Section 93 of the "California Standard Specifications". Divide the liters of asphalt at 15°C, as determined in Step (2), by the multiplier shown in the conversion table opposite the metering temperature.

NOTE: When meter's indication has been compensated by an automatic temperature compensator to 15°C or when a mass flow meter is used, it is not necessary to make a hot-liters calculation.

(4) Determine the percent of meter error thus: [100 times (calculated liters from Step (3) minus metered liters)] divided by calculated liters from Step (3).

EXAMPLE: 2176.6 L of asphalt metered at 135°C weighs 2041 kg. The specific gravity of the asphalt at 15°C is 1.020. Determine the percent of meter error using the mass of asphalt as the measuring standard.

1. 1.00 X 1.020 = 1.020 kg/L @ 15°C

2. 2041/1.02 = 2001.15 L @ 15°C

3. 2001.15 L/0.9269 = 2159.0 L @ 135°C

4. 100 X (2176.6-2159.0) /2159.0 = plus 0.8 % error.

g. Procedure to use when testing epoxy's meter for components is as follows:

(1) Determine the tare mass of the receptacle to the nearest 0.005 kilogram, and record it.

(2) Discharge a flow of epoxy's component through the meter being tested, at three varying time intervals representative of normal operating intervals, into the receptacle.

(3) Determine the unit mass per liter of the material being discharged through the meter at the operating temperature. This may be calculated from the specific gravity of the material.

NOTE: The specific gravity at *varying temperatures* may have to be furnished by the manufacturer of the product in conjunction with Caltrans Division of Materials Engineering and Testing Services (METS).

(4) Convert the mass of material metered in Step No. (2) to liters of material metered at operating temperature, and compare to the indicated liters metered. This is done by dividing the net mass in Step No. (2) by the unit mass per liter determined in Step No. (3).

(5) The error of the meter will be the average error of the three varying flows of material, but no individual check shall indicate an error of more than 1 %.

C. TEST

1. Test drafts for water meters tested by provers shall conform to maximum-rate test quantities indicated in Table 1.

   a. Wet the test measure.

      (1) For 40-L test measure or smaller, allow prover to drain 10 s after main flow ceases.

      (2) For test measures larger than 40 L, allow prover to drain 30 s after main flow ceases.

   b. Normal rate--at maximum rate.

   c. Special test.

      (1) For batch-plant and vehicle-tank water meters, only maximum- and intermediate-rate tests are required (Table 1).

   d. Printer operation. If the system is equipped with a printer, check during tests to determine printout's readability and agreement with the meter readings.

2. OPERATING CONDITIONS:

   a. Indicators shall start from, or return to, zero and shall not advance their indications before delivery of material.

   b. The preset device and indicators at a control panel or console shall indicate readings identical to those at the meter.

   c. Once a test is within tolerance, at least one additional test run shall be made for check of repeatability. The device shall repeat an indicated quantity within the tolerance specified for the meter.

   d. The temperature of the liquid shall be constant during individual test runs and recorded in order to permit converting kilograms to liters. When a mass flow coriolis effect meter is used, no specific gravity will be needed as no conversion will have to be done.

TABLE 1
Accuracy Test Flow Rates and Quantities

A					B			
MAXIMUM RATE					INTERMEDIATE RATE			
Meter Size mm (in.)	Rate of Flow L/min	Test Quantity		Accuracy Limits % Registration	Rate of Flow L/min	Test Quantity		Accuracy Limits % Registration
		Liters	Cubic Meters			Liters	Cubic Meters	
5.9mm (5/8)	60	200	0.2	98.5 - 101.5	8	40	0.04	98.5 - 101.5
9.1mm (3/4)	95	200	0.2	98.5 - 101.5	11	40	0.04	98.5 - 101.5
5.4mm (1)	150	400	0.4	98.5 - 101.5	15	40	0.04	98.5 - 101.5
8.1mm (1 1/2)	300	1200	1.2	98.5 - 101.5	30	200	0.2	98.5 - 101.5
0.8mm (2)	450	2000	2.0	98.5 - 101.5	60	200	0.2	98.5 - 101.5
6.2mm (3)	950	2000	2.0	98.5 - 101.5	80	200	0.2	98.5 - 101.5
01.6mm (4)	1325	4000	4.0	98.5 - 101.5	150	400	0.4	98.5 - 101.5
52.4mm (6)	2650	4000	4.0	98.5 - 101.5	225	400	0.4	98.5 - 101.5

PART 5 TEST PROCEDURE FOR BELT OR CONVEYOR SCALES

A. INSPECTION – SEE PART 1

1. The following markings are required on the model identification plate:

   a. The rated capacity in units of mass per hour.

   b. The belt speed in meters per minute at which the belt will deliver the rated capacity.

   c. The value of the smallest unit on the master totalizer of masses.

   d. Number of units of mass totalized for a specific chain (kg/m), for a specific number of meter of belt travel, or for a specific load of test masses for a specific number of meters of belt travel, or for a specific calibrating plate (kg/m) for a specific number of meters of belt travel. (To be marked after calibration.)

2. The scale and conveyor at the scale shall be protected from the wind and weather.

3. Installation shall be in accordance with the scale manufacturer's instructions, a copy of which shall be furnished to the Engineer. Incline of belt must be such that there is no slippage of material along the belt.

   Unless the scale is "non-contact" or nuclear, or is installed in a short conveyor designed and furnished by the scale manufacturer or built to the scale manufacturer's specifications, the conveyor shall comply with the following requirements:

   a. Take-up devices shall be of the counter-weight type.

   b. The scale shall be installed at least 6 m or five idler spaces, whichever is greater, from loading point, skirting, training idlers, head or tail pulley, or convex curve in conveyor.

NOTE: CONCAVE CURVE--A change in the angle of inclination of a belt conveyor where the center of the curve is above the conveyor.

CONVEX CURVE--A change in the angle of inclination of a belt conveyor where the center of the curve is below the conveyor.

   c. There shall be no concave curve in conveyor belt between the scale and the loading point. A concave curve beyond the scale shall start no closer than 21 m from the scale.

   d. There shall be no trippers in the conveyors.

   e. The conveyor shall be no longer than 600 m from head to tail pulley.

   f. The angle of the troughing idlers shall not exceed 35 degrees from the horizontal.

   g. The idlers on the scale and at least two before and two after the scale shall be collinear, at 90 degrees to the belt's centerline and spaced properly, according to the manufacturer's instructions.

   h. Conveyor's stringers at the scale and for no less than 6 m before and beyond the scale shall be continuous or securely joined and of sufficient size and so supported as to eliminate relative deflection between the scale and adjacent idlers under load.

   i. Conveyor's belting shall be no heavier than is required for installation. When loaded to 50 % or more of scale capacity, the belt shall contact the center or horizontal portion of the idlers.

B. TEST EQUIPMENT AND PROVISIONS

1. Proper means for making simulated tests shall be provided by the Contractor; e.g., chain, calibration plate, and the scale shall be calibrated. Approved simulated tests may be used to confirm calibration; the first test of the device shall be a test with material correlated to the simulated test; subsequent tests may be simulated.

2. The Contractor shall provide a suitable container or containers, capable of receiving a full ten-minute delivery of material being conveyed over the belt.

3. The Contractor shall provide a suitable scale for confirming masses obtained from the belt-

conveyor scale. This scale shall have been tested, in the presence of the Engineer, for accuracy by authorized personnel or agencies within 24 h prior to making a test run.

4. If the belt or conveyor has been idle for a period of 2 h or more, the empty conveyor shall be run for not less than 15 min before the start of the test.

5. The belt or conveyor scale shall be tested after it is installed on the conveyor with which it is to be used and under normally expected environmental conditions.

C. TEST

1. A zero-load test is conducted as follows: The initial test shall be conducted with the belt or conveyor empty for not less than 10 min and for not less than three circuits of the belt. The counter shall be read when a spot marked on the belt passes a spot marked on the conveyor's frame, before and after the test. If the zero-load error is more than 0.1 % of rated capacity, the device shall be adjusted, and the zero-load test must be rerun before continuing.

2. The scale shall be tested between 50 % and 100 % of rated capacity. Each test shall not be less than: (a) 10 % of rated hourly capacity or (b) one revolution of the belt, or (c) A count of 500 on the primary totalizer.

3. Use the same material that will be used in production. Pass a pre-weighed quantity of material over the belt or conveyor scale in a manner similar to actual loading conditions, or on a suitable scale, statically weigh all material that has passed over the belt or conveyor scale during a test with that material.

   a. The containers, whether they be railroad cars, trucks, or boxes, must not leak, and they must not be overloaded to the point that material will be lost.

   b. Empty, or tare, masses of containers will be determined at the time of test.

   c. When a preweighed test load is passed over the scale, the belt-loading hopper must be examined before and after the test to assure that the hopper was empty.

4. A minimum of three test runs will be made with material. The average of the three runs shall be within 0.5 % of the applied test load, except that no individual test run shall exceed a variance of 1.0 %. When any individual test run varies from the applied test load by more than 1.0 %, a new series of three runs shall be performed.

PART 6. TEST PROCEDURE FOR SELF-CONTAINED BELT SCALES

A. INSPECT SCALE – SEE PART 1

1. Scale shall be protected from the wind and weather.

2. Installation shall be in accordance with the scale manufacturer's instructions, a copy of which shall be furnished to the Engineer.

B. TEST EQUIPMENT AND PROVISIONS

1. One or more containers, capable of receiving a full 3 min delivery of material being conveyed over the belt scale, shall be provided by the Contractor. All containers must be lead proof.

2. The Contractor shall provide suitable means of pre-weighing or after-weighing the full amount of the test-run material.

3. The container shall provide a scale suitable for confirming masses obtained from the belt scale. This scale shall have been tested, in the presence of the Engineer, for accuracy by authorized personnel or agencies within 24 h prior to making a test run.

4. The scale shall be tested in its operating location with all operating conditions prevailing.

C. TEST

1. Static Loading: Set zero-load balance with all attachments and equipment for applying test loads in place. Apply test loads as outlined for hopper or tank scales.

2. Dynamic Loading:

a. Set zero-load balance with the belt in motion with all necessary attachments for normal operation and applying the test load.

b. Apply test loads at 50 %, 75 %, and 100 % of rated capacity and less than 50 % if it is intended to operate at lower rates. Each test shall be not less than 3 min in duration.

   (1) Use the same material that the device is to be used to measure.

   (2) Containers must not be overloaded to the point that material will be lost.

   (3) Actual tare masses of containers will be determined at time of test.

   (4) When a preweighed test load is passed over the scale, the belt-loading hopper must be examined before and after the test to assure that all the material passed over the scale.

c. The tolerance and method of determining the scale's accuracy are as follows:

   (1) A minimum of three 3-min test runs shall be made at varying percents of full capacity.

   (2) The average of the three runs shall be within 0.5 % of the applied load, except that no individual test run shall exceed a variance of 1.0 % from the confirming mass obtained for that test run. If one test run exceed a variance of 1.0 %, a new series of three tests shall be made.

PART 7. TEST PROCEDURE FOR CHECKING ACCURACY OF CONTNUOUS MIXING ASPHALT CONCTETE PLANT PROPORTIONING DEVICES

PROPORTIONING DEVICES Error-test the required vehicle scale, to be used as the test standard, with test loads of known mass. This must be done within the 24 h prior to testing the accuracy of the proportioning devices. A build-up method may be used to check that portion of the scale capacity in excess of 25 % of its operational limit. The minimum graduation of the vehicle scale's indicator shall not be greater than 0.01 tonne.

NOTE: When testing continuous mixing AC plants with computer-control systems, the means of observing the input settings for span adjustment will be a digital display. The manufacturer must supply the instructions on how the span numbers for the adjusting elements are displayed. The HQ Office of the Construction Program will be responsible for reviewing all new proportioning systems for acceptability and supplying the instructions for inspection of each system accepted for use in producing asphalt concrete for Caltrans projects.

At the conclusion of a successful test of the proportioning devices, record the span-adjustment settings, and make them available to the plant inspector. Where the adjusting elements do not produce a span number the device shall be left in a secure condition by the placing of a physical security seal. Refer to Section 9-1.01, paragraph 4, "Measurement of Quantities," of the July 1999 Standard Specifications.

Always check the rate indicator against the totalizer's indicator for at least 1-min intervals. Time the interval with a stopwatch. The indicated rate should be within 1 % of the rate determined by the totalizer.

When an individual proportioning controller is used which is separate from the plant controller, this device shall be tested and calibrated separate from the main plant controller. After the successful testing of the separate, stand alone device, the plant controller shall be adjusted to track the calibrated proportioning device.

NOTE: An example of this would be the Micro Motion mass flow meter. The meter is supplied with it's own transmitter. This separate, stand-alone metering device is calibrated and then the controller that handles the combined plant function is adjusted to track the meter transmitter. The same could be true of a Ramsey weighbelt controller.

AGGREGATE BELT SCALE ACCURACY TEST

1. The belt scale (weighbelt) must be warmed up by being operated for at least 30 min. Then make a zero-load check run of the weighbelt while it is being operated in an unloaded condition.

2. Record the position of the weighbelt's adjustment elements for each series of tests. Each series of tests shall consist of at least 3 runs of a minimum quantity of 3 min.

3. A truck, capable of holding at least the discharge from a run at 100 % of the maximum operating

capacity of the plant for 3 min, must be tarred before each test run.

In the event the aggregate production rate is to exceed 400 TPH, the high speed calibration attempt may be a set of two runs, of two minutes each, for each calibration rate greater than 400 TPH. The average error for each pair of runs shall not exceed 1 %. This average high-speed error shall be used as the high-speed result(s).

4. Record span-adjustment setting and reading of the belt scale's totalizer before each test run. Divert a minimum of 3 min flow of aggregate into the truck directly from the feeder belt at each of the following rates of flow: 30 %, 65 %, and 100 % of the desired maximum production rate. The test run set up shall be free from leaks and must not lose excess product into the atmosphere.

    a. The total mass of the aggregate for each of these runs, indicated by the totalizer, must be within 2.0 % of the actual mass of the material diverted into the truck as determined by the vehicle scale, the standard for this test. The average deviation of the three test runs (sum of the deviations of the three individual test runs divided by 3) shall not exceed 1.0 %.

    b. If the device is adjusted before completion of the three calibration runs, the test is aborted, and a new series must be initiated.

ASPHALT METER-ACCURACY TEST

All Meter Types -

1. A tank truck, with a minimum capacity of 4000 L, must be tared on the previously error-tested section of the vehicle scale to be used as the test standard.

2. Record the position of the meter's adjustor for each series of tests. Each series of tests shall consist of at least 3 runs of a minimum quantity of 4000 L each at rates of flow commensurate with the 3 rates of flow of the aggregate. (Apply the bitumen ratio from the proposed job-mix formula to the aggregates' rates of flow to determine rates of flow for asphalt.)

    a. The meter reading indicated for the metered asphalt for any test run shall be within 1.0 % of the liters determined by weighing the metered asphalt on the previously error tested vehicle scale. (Calculations to determine the actual liters of metered asphalt will be in accordance with Form HC-0014.) The average difference between the indicated mass of asphalt delivered and the actual mass of asphalt delivered shall not exceed 0.5 % of the actual mass of asphalt delivered as determined by the scale masses for the 3 test runs of the test series.

    b. If the device is adjusted before completion of the three calibration runs, the test is aborted, and a new series must be initiated.

Mass Flow Meters -

1. The indication for the mass flow meter shall be in mass. Compare the actual mass indicated by the vehicle scale with the mass indicated by the meter.

Volumetric Meters -

1. The specific gravity of the grade of asphalt to be metered must be obtained from the refinery and must have been determined for the specific lot of asphalt being delivered. At the time of testing the meter, take a sample of the asphalt. Immediately send it to METS for a confirming determination of its specific gravity.

NOTE: If the confirmed specific gravity is such that the meter's accuracy is within 0.5 %, the meter may be adjusted without running subsequent accuracy tests. If the adjustment requires more than a 0.5 % change, a new series of tests of the asphalt meter shall be run.

NOTE: If the contractor elects to operate the plant during production with the temperature of the asphalt controlled within a range of ±25°C of the average asphalt temperature at the time of testing, it will not be required to test an automatic temperature compensator (ATC) for accuracy.

If the contractor elects to operate the plant without this restriction of temperature, step 2, below, must be performed.

2 If any of the above test runs are out of tolerance, a test run must be made with the ATC disengaged or once the meter has been proven accurate at the testing temperature, a subsequent test run with a minimum temperature change of 20°C must be made to demonstrate accuracy of the ATC control.

NOTE FOR BROOKS MECHANICAL METERS: To determine whether the gear adjustor is in need of correction and to avoid adjusting the gear adjustor to compensate for an erroneous ATC the ATC may be disengaged on the later models (4400 Model) by a lever, a lock-out device, built into the system by the manufacturer. The earlier models (4500 Model) will have to be removed, or the capillary tube sensing system must be placed in a 15°C bath. When the corresponding gear changing unit is left in the stack, with the ATC disengaged, a correction factor must be applied to the meter reading.

For Gear Changer No. 5900-940, multiply meter reading by 1.064. For Gear Changer No. 5900-896, multiply meter reading by 1.116.

If upon making the test run with the ATC disengaged, the indicated meter reading differs from the actual asphalt metered in excess of 0.5 %, the gear-adjustor setting should be adjusted accordingly. If the difference is within acceptable tolerance, the ATC should be re-engaged. After adjustment of the ATC, its accuracy must be proven by a subsequent test run. Complete the test series by making runs at both the high and low rates of flow.

PART 8. SCALE AND METER TOLERANCES

A. TEST ACCURACY FOR HOPPER OR TANK SCALES

Hopper or tank scales shall be accurate to within two minimum graduations.

B. TEST ACCURACY FOR BELT OR CONVEYOR SCALES

Belt or conveyor scales shall be accurate to within 0.5 % of the test load. This tolerance applies to the average of three test runs of material; no individual test run shall exceed a variance of 1.0 % from the confirming mass.

Belt or conveyor scales for continuous mixing AC plants shall be accurate to within 1.0 % of the test load for an average of three test runs; no individual error may exceed 2.0 %.

C. TEST ACCURACY FOR METERS

1. Water meters shall be accurate to within 1.5 % of the test draft. Water meters for use on plants used for the lime slurry treatment of AC aggregates shall be accurate to within 1.0 %.

2. Asphalt and epoxy component meters shall be accurate to within 0.5 % of the test draft. This tolerance applies to the average of three test runs of material.

   Meters used for proportioning at continuous mixing AC plants shall be accurate to within 0.5 % of the test load for an average of three test runs; no individual error may exceed 1.0 %.

D. INDICATORS

1. All primary indicators shall be suitable for the purposes intended and shall be accurate to the applicable tolerance of the device attached thereto.

2. Remote-control indicators, if used for the actual control of weighing, shall be considered the primary indicators and shall meet all requirements for primary indicators.

REFERENCE
California Standard Specifications

End of Text
(California Test 109 contains 12 pages)